

Application No. 10/526,397
Reply to Office Action of December 11, 2006

IN THE DRAWINGS

The attached sheet of drawings includes changes to the figure. This sheet, which includes the figure, replaces the original sheet including the figure.

Attachment: Replacement Sheet

REMARKS/ARGUMENTS

Claims 13-29 are pending. By this Amendment, the figure is amended, claims 1-12 are cancelled, claims 13-19 are amended, and new claims 20-29 are presented. Support for the amendments to the figure can be found, for example, in the original figure. Support for the amendments to claims 13-19 can be found, for example, in the present specification at page 18, lines 6 to 22, and in original claims 1, 4 and 13-19. Support for new claims 20-29 can be found, for example, in original claims 2, 3 and 5-14. No new matter is added. In view of the foregoing amendments and following remarks, reconsideration and allowance are respectfully requested.

Shore

The Office Action rejects claim 19 under 35 U.S.C. §102(e), or in the alternative under 35 U.S.C. §103(a), over U.S. Patent No. 6,541,419 to Shore et al. ("Shore"). Applicants respectfully traverse the rejection.

Claim 19 recites "[a] fuel cell system, comprising: a desulfurizer; and a reforming apparatus; wherein: the desulfurizer comprises an adsorbent comprising cerium oxide having primary particles with a mean crystallite size of 10 nm or less, the desulfurizer being configured so that a hydrocarbon fuel can be contacted to the adsorbent; and the reforming apparatus comprises a catalyst comprising at least one member selected from the group consisting of a partial-oxidation reforming catalyst, an autothermal reforming catalyst, and a steam reforming catalyst, the reforming apparatus being configured so that a desulfurized fuel can be contacted to the catalyst" (emphasis added). Shore fails to disclose or suggest such a system.

The Office Action asserts that Shore discloses a fuel cell system having no distinction from the fuel cell system of claim 19. See Office Action, page 2. Applicants submit that

Shore provides no teaching or suggestion of an adsorbent including cerium oxide having primary particles with a mean crystallite size of 10 nm or less. Shore discloses a sorber that may include a "metal selected from the group consisting of zinc, calcium, nickel, iron, copper and mixtures thereof." *See Shore*, column 2, lines 32 to 35. There is no disclosure or suggestion in Shore that the disclosed sorber could or should include cerium oxide.

Applicants note that Shore discloses that the sorber may be carried on a monolith carrier. *See, e.g., Shore*, column 2, lines 1 to 5. The monolith carrier may be formed from a material such as zirconia-ceria. *See Shore*, column 2, line 64 to column 3, line 1. Thus, the system of Shore may include cerium oxide. However, there is no disclosure or suggestion that that the cerium oxide has primary particles with a mean crystallite size of 10 nm or less. The only disclosure of particle size in Shore relates to the particle size of the sorber, which is supported by the monolith carrier, not the monolith carrier itself – moreover, the monolith carrier of Shore appears to have a much larger particle size than the cerium oxide of claim 19. *See Shore*, column 3, lines 38 to 51. There is no disclosure or suggestion in Shore of an adsorbent comprising cerium oxide having primary particles with a mean crystallite size of 10 nm or less.

For the reasons discussed above, a *prima facie* case of obviousness has not been made. However, even if a *prima facie* case were made, such case is rebutted by the results shown in the present specification – "[a] *prima facie* case of obviousness ... is rebuttable by proof that the claimed compounds possess unexpectedly advantageous or superior properties." *See MPEP §2144.09* (citing *In re Paesch*, 315 F.2d 381 (C.C.P.A. 1963)). The Examples of the present specification demonstrate that fuel cell systems including adsorbents comprising cerium oxide having primary particles with a mean crystallite size of 10 nm or less, such as recited in claim 19, provide superior capabilities relative to fuel cell systems employing cerium oxide having a greater particle size. *See, e.g.,* present specification, page

25, Tables 1 and 2 (compare Examples 1 and 2 and Comparative Example 1). These results are objective evidence of the improvements of the fuel cell system of claim 19 over known fuel cell systems, such as in Shore, and thus these results rebut any suggestion that it would have been obvious to modify the system of Shore to obtain the system of claim 19.

As Shore fails to disclose or suggest a fuel cell system including an adsorbent comprising cerium oxide having primary particles with a mean crystallite size of 10 nm or less, Shore fails to disclose or suggest each and every feature of claim 19.

Claim 19 is not anticipated by and would not have been rendered obvious by Shore. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Ino

The Office Action rejects claims 1-12 under 35 U.S.C. §102(b), or in the alternative under 35 U.S.C. §103(a), over U.S. Patent No. 5,268,346 to Ino et al. ("Ino"). By this Amendment, claims 1-12 are cancelled, rendering the rejection moot. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Kay

The Office Action rejects claims 1 and 5-12 under 35 U.S.C. §102(b), or in the alternative under 35 U.S.C. §103(a), over U.S. Patent No. 5,326,737 to Kay et al. ("Kay"). By this Amendment, claims 1 and 5-12 are cancelled, rendering the rejection moot. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Gislason

The Office Action rejects claims 1-12 under 35 U.S.C. §102(e), or in the alternative under 35 U.S.C. §103(a), over U.S. Patent No. 6,914,033 to Gislason et al. ("Gislason"). By

this Amendment, claims 1-12 are cancelled, rendering the rejection moot. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Gislason and Ino

The Office Action rejects claims 13-18 under 35 U.S.C. §103(a) over Gislason in view of Ino. Applicants respectfully traverse the rejection.

Claim 13 recites "[a] process for producing hydrogen, comprising: desulfurizing a hydrocarbon fuel by contacting the hydrocarbon fuel to an adsorbent comprising cerium oxide, primary particles of the cerium oxide having a mean crystallite size of 10 nm or less; and subsequently bringing the desulfurized fuel into contact with a catalyst comprising at least one member selected from the group consisting of a partial-oxidation reforming catalyst, an autothermal reforming catalyst, and a steam reforming catalyst" (emphasis added).

Gislason and Ino do not disclose or suggest such a process.

The Office Action asserts that Gislason discloses desulfurizing a hydrocarbon fuel by contacting the fuel with a cerium oxide adsorbent. *See* Office Action, page 3. Gislason does not explicitly disclose or suggest a cerium oxide adsorbent having primary particles with a mean crystallite size of 10 nm or less. The Office Action appears to assert that such particle size would have been inherent from the teachings of Gislason because the cerium oxide of Gislason is produced in the same manner as disclosed in the present specification. *See* Office Action, page 3. However, the Office Action fails to demonstrate that the particle size recited in claim 13 would necessarily result from the production method disclosed in Gislason. It is plain that "[t]he fact that certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of the result or characteristic." *See* MPEP §2112.IV (citing *In re Rijckaert*, 9 F.3d 1531 (Fed. Cir. 1993)) (emphasis in original). In this case, exemplary methods according to the present invention yield hydrocarbon streams

having sulfur concentrations of 0.1 ppm or less (*see, e.g.*, present specification, page 16, lines 15 to 21; Tables II, III and IV), while the methods according to Gislason yield hydrocarbon streams having far greater sulfur concentrations (*see, e.g.*, Gislason, column 2, lines 58 to 64; Tables II and IV). This difference in performance is evidence that cerium oxides employed in the process of claim 13 differ in composition and/or structure from the cerium oxides disclosed in Gislason. Accordingly, the Office Action's assertion the particle size recited in claim 13 would have been inherent from the teachings of Gislason cannot be sustained – Gislason does not disclose or suggest employing an adsorbent comprising cerium oxide having primary particles with a mean crystallite size of 10 nm or less.

Ino does not remedy the deficiencies of Gislason. As with Gislason, there is no disclosure or suggestion in Ino that the disclosed ceria has primary particles with a mean crystallite size of 10 nm or less, as recited in claim 13. The Office Action appears to assert that the particle size of claim 13 would have been inherent from the teachings of Ino. *See* Office Action, page 4. However, the methods by which the cerium oxides of the present application and the cerium oxides of Ino are made are not identical and the Office Action fails to demonstrate that the particle size recited in claim 13 would necessarily result from the production method disclosed in Ino. Ino does not disclose or suggest employing a cerium oxide as an adsorbent for sulfur compounds, much less employing a cerium oxide adsorbent having primary particles with a mean crystallite size of 10 nm or less, which yields an even greater adsorbing property.

The Office Action asserts that Ino discloses desulfurizing a hydrocarbon fuel by contacting the fuel with a cerium oxide adsorbent. *See* Office Action, page 4. Ino does not disclose a desulfurizing step employing cerium oxide at all. In Ino, a hydrocarbon stream that has already been subjected to desulfurization is subjected to a reforming reaction employing a reforming catalyst including ruthenium and, *e.g.*, ceria. *See, e.g.*, Ino, column 2,

lines 14 to 23, column 4, lines 36 to 40. This is an entirely different application of cerium oxide than is recited in claim 13. Claim 13 is directed to a method including desulfurizing with cerium oxide and subsequently reforming with a reforming catalyst. Ino, by contrast is directed to method including desulfurizing with hydrogen and subsequently reforming with ruthenium and ceria. Ino does not disclose or suggest the method steps of claim 13.

Moreover, there is nothing in either of the references that remotely suggests that a reforming catalyst, as disclosed in Ino, could or should be used in a desulfurization reaction, as disclosed in Gislason.

Moreover, as discussed with respect to Shore above, even if a *prima facie* case of obviousness were made, such case is rebutted by the results shown in the present specification. The Examples of the present specification show that fuel cell systems including adsorbents comprising cerium oxide having primary particles with a mean crystallite size of 10 nm or less, such as recited in claim 13, provide superior performance relative to fuel cell systems employing cerium oxide having a greater particle size. *See, e.g.,* present specification, page 25, Tables 1 and 2 (compare Examples 1 and 2 and Comparative Example 1). These results are objective evidence of the improvements of the process of claim 13 over known processes, such as in Gislason and Ino, and thus these results rebut any suggestion that it would have been obvious to combine or modify the teachings of Gislason and Ino to obtain the process of claim 13, as proposed in the Office Action.

As neither Gislason nor Ino discloses or suggests employing an adsorbent comprising cerium oxide having primary particles with a mean crystallite size of 10 nm or less, and as one of ordinary skill in the art would not have been motivated to combine the teachings of Gislason and Ino, the combination of references fails to disclose or suggest each and every feature of claim 13.

Claim 13 would not have been rendered obvious by Gislason and Ino. Claims 14-18 depend from claim 13 and, thus, also would not have been rendered obvious by Gislason and Ino. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Ino and Gislason

The Office Action rejects claims 13-18 under 35 U.S.C. §103(a) over Ino in view of Gislason. Applicants respectfully traverse the rejection.

Claim 13 is set forth above. For the reasons discussed above, Ino and Gislason fail to disclose or suggest each and every feature of claim 13.

Claim 13 would not have been rendered obvious by Ino and Gislason. Claims 14-18 depend from claim 13 and, thus, also would not have been rendered obvious by Ino and Gislason. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Ino

The Office Action rejects claims 13-18 under 35 U.S.C. §102(b), or in the alternative under 35 U.S.C. §103(a), over Ino. Applicants respectfully traverse the rejection.

Claim 13 is set forth above. For the reasons discussed above, Ino fails to disclose or suggest each and every feature of claim 13.

Claim 13 is not anticipated by and would not have been rendered obvious by Ino. Claims 14-18 depend from claim 13 and, thus, also are not anticipated by and would not have been rendered obvious by Ino. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Murota

The Office Action rejects claims 1-12 under 35 U.S.C. §102(b), or in the alternative under 35 U.S.C. §103(a), over EP 0 629 438 A2 to Murota et al. ("Murota"). By this Amendment, claims 1-12 are cancelled, rendering the rejection moot. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Maruo

The Office Action rejects claims 1 and 12 under 35 U.S.C. §102(b), or in the alternative under 35 U.S.C. §103(a), over JP 6-254389 to Maruo et al. ("Maruo"). By this Amendment, claims 1 and 12 are cancelled, rendering the rejection moot. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Rejection Under 35 U.S.C. §112, Second Paragraph

The Office Action rejects claims 7-12 and 19 as indefinite under 35 U.S.C. §112, second paragraph. By this Amendment, claims 7-12 are cancelled. As to the remaining claim, Applicants respectfully traverse the rejection.

The Office Action asserts that claim 19 recites improper Markush language. By this Amendment, the pending claims are amended to recite proper Markush language, rendering the rejection moot. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Rejection Under 35 U.S.C. §112, Fifth Paragraph

The Office Action rejects claim 19 as an improper multiple dependent claim under 35 U.S.C. §112, fifth paragraph. Applicants respectfully traverse the rejection.

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By this Amendment, claim 19 is amended to be an independent claim, rendering the rejection moot. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

Objection to Drawing

The Office Action objects to the drawings as improperly identifying the sole figure as Figure 1. By this Amendment, the figure is amended to obviate the objection. Accordingly, reconsideration and withdrawal of the objection are respectfully requested.

Conclusion

For the foregoing reasons, Applicants submit that claims 13-29 are in condition for allowance. Prompt reconsideration and allowance are respectfully requested.

Respectfully submitted,

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